Assessment of virus movement across continents: using northern pintails as a test

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Personnel from the USGS Alaska Science Center, National Wildlife Health Center, and Western Ecological Research Center are collaborating with colleagues from the U.S. Fish and Wildlife Service, University of Tokyo, Miyagi Prefectural Izunuma-Uchinuma Foundation, and the Yamashina Institute of Ornithology to study whether migratory birds might carry the highly pathogenic H5N1 avian influenza virus from Asia to North America. We are using Northern Pintail ducks (Anas acuta) as a model species to study intercontinental virus transmission because the species frequently migrates between Asia and North America, is abundant, and often carries avian influenza viruses. The various aspects of this project include: (1) an evaluation of spatial and temporal overlap of North American and Asian pintail populations through analysis of band recoveries, and marking of Northern Pintails with satellite transmitters on their Japanese wintering areas, (2) comparison of genetic differentiation of Asian and North American pintails to determine the degree to which populations are reproductively isolated, and (3) contrasting of strains of non-H5N1 viruses found in Northern Pintails on Japanese wintering areas and those on North American breeding and wintering areas to assess the recent and historic transcontinental transmission of avian viruses.

We have marked 79 Northern Pintail ducks in Japan with satellite transmitters, and tracked their migration to nesting and molting areas in Russia; primarily the Kamchatka and Chukotka peninsulas. Northern Pintails marked with leg bands in North America have also often been found in those areas of Russia. Thus there is a large area in eastern Russia where pintails from Japan and North America likely come into contact with each other in summer.

We collected DNA samples from 77 wintering pintails in Japan and 147 pintails throughout wintering areas in California. We used mitochondrial and nuclear DNA markers to assess the degree of genetic contact (i.e., gene flow) between groups of Northern Pintail ducks that winter in Japan and California. There was no evidence for genetic differentiation between the two groups using either type of genetic marker. Thus pintails in Asia regularly come into contact and interbreed with Northern Pintails from North America.

We conducted a whole genome analysis of low pathogenic avian influenza viruses collected from Northern Pintails in Alaska and found evidence of inter-continental virus exchange at a higher frequency than previously documented. In 38 virus isolates from Alaska, nearly half (44.7%) had at least one gene segment more closely related to Asian than to North American strains of influenza virus.

Our findings that (1) Northern Pintails from Japan and North America are sympatric over a large area of eastern Russian in summer, (2) pintails from North America and Asia freely interbreed, and (3) Northern Pintails in Alaska regularly carry avian influenza viruses that have a genetic link to Asia, supports the hypothesis that wild birds may transfer avian influenza viruses between continents, and that there is a higher degree of virus transfer between Asia and Alaska than elsewhere.

In 2009 we will deploy satellite transmitters on an additional 50 Northern Pintails in Japan and expand the project to include marking of 17 Whooper Swans with satellite transmitters. In addition we will collaborate with scientists from Kitasato University in genetic sequencing of low pathogenic viruses collected from Northern Pintails and Whooper Swans in Japan.

Findings are summarized on a project web site at: